

STATED PREFERENCE DATA & ALOGIT

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ABSTRACT

Stated Preference (SP) surveys are a form of experimental surveys in which the respondent states his/her preferences towards to an alternative out of a set of alternatives that they are presented with. The process of analysing the data collected and estimating the utility of the alternatives under investigation found through such surveys, depending on the nature of the survey design and its underlying details, can be time consuming and cumbersome. If the data is to be studied using logit models, the ALOGIT software can be used which is a powerful tool used for utility maximization and estimations of a SP survey data set. The software requires development and use of a special and often quite lengthy code. This paper presents the reader with a specific yet immensely useful computer program to be used in ALOGIT for estimations when working with SP data and logit models involving ranking and rating of alternatives.

KEYWORDS

ALOGIT Code, State Preference Data, Logit Models, Utility Maximization

1. INTRODUCTION

Stated Preference (SP) surveys have the capability to capture the patterns in the real world associated with a set of alternatives [1]. In such surveys the respondent is presented with a set of alternatives pertaining to a specific topic and asked to choose their priority and sometimes rate and rank their alternatives of choice. If logit models are used to evaluate the survey results, the data is compiled, cleaned, and weighted using census data such as reference [2] in order to go through a utility maximization process to be able to discern people's behaviours towards the alternatives under study such as travel modes or behaviours towards high-speed rail options [3,4].

Using SP data is of popularity among scholars especially in the area of Transportation Engineering research as seen in references [5 – 16]. The research in reference [5] demonstrates how SP data has made it possible for cost effective investigations in the transportation research area. This is so as in a SP survey, future alternatives that may not necessarily be in place, can be presented to the transport system users in a survey to detect their potential sensitivity towards such alternatives. For example, the respondent to an SP survey could be presented with auto, taxi, and bus modes along with a “high-speed rail” option which may not exist in their respective city. This will then require the survey respondent to choose among the alternatives they are presented with for a hypothetical journey.

Through trial and error, the user's sensitivity, sometimes along with ranking and rating of alternatives, can then be discerned given the SP data is analyzed through relevant simulations such as logit or probit models.

SP data are also useful in the area of rail transportation research as seen in reference [6] which has used SP and Revealed Preference RP data for forecasting intercity rail usage. The RP data are collected by observing what alternatives the users have in fact picked rather than what they had stated they would pick in an SP survey.

Another work [7] has focused on the use of SP data specifically in travel demand modelling which is similar to the study herein for which the code presented here was developed. A similar work [8] has focused on the usage of SP and RV data in combination and analyzed the opportunities and limitations associated with that method. Some advanced research as seen in [9, 10] have utilized SP data to analyze transfers between modes of travel and travel choice in general. A more recent work in reference [11] has focused on the specific terminology related to SP data.

As seen in the above references and in numerous other research articles, the use of SP data has made it possible for transportation research, travel forecasting, and detailed analysis in the past few decades. In this regard, when it comes to modelling SP results, through logit models, various relevant software is developed. The available software that allows for utility maximization process on SP data are diverse such as ALOGIT [17] and SPSS [18].

This paper focuses on the characteristics of the former pertaining to utility maximization of logit models to be performed on a specific SP data set involving rankings and ratings of transportation alternatives. In the majority of the work involving ALOGIT, the underlying code for analysis is not made available to the readers while its development can be one of the most onerous steps when analyzing SP data. In this regard, the code presented here is tried and true and developed by the author for a detailed survey as explained in the method section and is to be run in ALOGIT 4 to produce estimations of relevant logit model parameters. This code can act as a guide for researchers to get started with ALOGIT and bypass the tremendous work one needs to put into developing such often lengthy code.

2. LITERATURE REVIEW

2.1. Alogit

ALOGIT is a very powerful and fast logit model estimation software capable of handling various data such as stated preference, revealed preference, aggregate, or disaggregate data [5+12]. The software works by developing a code through which the data and associated logit models including any ranking and rating can be analysed and parameters estimated along with their Correlation of Estimates.

The code that needs to be developed will have several different characteristics depending on the nature of the study, the number of alternatives, and the ranking and rating systems if any are to be used during conducting the SP survey. The most recent version of the software (version 4) accepts a code that is different in several ways from the older versions (version 3) of the software and requires efforts and many trial and errors on the researcher's part. If adjustments and refinements are done to the logit models, the code becomes yet more complicated and would require much labour and time to perfect.

2.2. Adjustments and Refinements

When logit models' estimations are done to process SP data, there are several refinements that can be applied while which can reduce the potential errors stemming from assumptions made towards such models. The experiment presented here has considered three of such adjustments. The first SP data adjustment accounts for the effects of using a sample with differential sampling rates across the population. The second adjustment accounts for using a sample with variations in the probability of alternatives availability in the choice set.

The third adjustment accounts for the effects of using a sample with more than one observation from each individual. Aside from showing the effect of tree adjustments, the main intention of this chapter is to show the effects of the three SP adjustments. For more information regarding logit models and the associated three refinements mentioned above, the reader is encouraged to see [19].

3. METHOD

Here the SP survey and its characteristics are explained as it is necessary if one is to understand how the associated ALOGIT code is set up in this particular case. The SP survey presented here is part of a larger study investigating “passenger modes of travel” using logit models, ALOGIT, and various alternatives nesting structures. Detailed information on the study can be found in [20]. The survey involves a set of alternatives for modes of transportation investigating what individuals’ preferences are about what mode to use when getting to and returning from a hypothetical meeting.

The alternatives include a bus option, a taxi option, or asking friends and relatives for a ride who are divided based on if they are already planning to drive or not planning to do so. In the latter, the respondent would be in fact imposing a ride on the driver. The attributes chosen for each option are diverse such as cost and time of arrival. The respondent is presented with five card two of which are always bus options and the rest are a random selection of other modes of travel. The individual is then asked to choose what modes in order of preference they would use if driving alone was not an option for them to get to/return from their hypothetical meeting.

The “game” is repeated six times in total and each time the travel modes alternatives are arranged, ranked, and rated by the respondent. The answers form each respondent is then copied to a predesigned form which is to be used for data entry into spreadsheets later in the research process. These choices that a survey respondent makes can be affected by their socio-economic characteristics and their overall reason for making the trip in the first place. Thus, the survey respondent is asked about their basic demographic factors as well as their level of shyness to be used as a means to measure their deterrence to ask for a ride from someone else.

A logit model is then used here to model each individual mode of travel option and their probability of being selected by a traveller. Prior to modelling the choices, a set of utility functions are developed for all travel modes to represent it using associated attributes such as time and cost. Figure 1 shows a typical survey card.

Bus				
Walk Distance to Stop	Ride Time Stop to Stop	Bus Fare one-way	Walk Distance from Stop	Arrive Before or Leave After Meeting
1 blocks	15 minutes	1.00 \$	1 blocks	5 minutes

1 B A A

Figure 1: A Typical SP Survey “game” Card

Figure 2 represents all the available alternatives assuming no tree structure followed by Figure 3 which shows the survey sheet used to record the responses as well as individuals' socio-demographic characteristics. Table 1 represents sample parameters used for two of the alternatives namely bus and taxi.

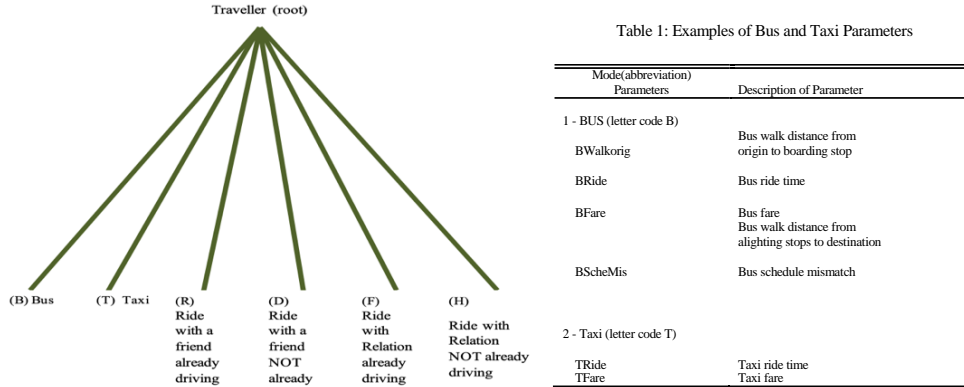


Figure 2: Utility Functions with Simple Tree Structure

Interviewer: _____ Set: _____ Interview Number: _____ Date: _____

- Consider journey where you are travelling from home to an all-day meeting and back home again; weather is good
- You do not have a car available for you to use as a driver
- You do not have any transit pass for this journey and must pay the full fares indicated here in all cases
- Consider alternative journey possibilities:
 - Different modes and arrangements, some involving friends or relations driving you
 - Relation is someone in your immediate family living in your household
 - Some involve arriving at meeting place early before meeting starts (with a wait time before meeting) or leaving from meeting place later after meeting ends (with a wait time after meeting); always waiting inside
 - With different times and costs possible
 - Described on cards
- Randomly select 2 cards from blue deck and 3 cards from white deck and put in order of preference and also rate on 0-10 scale; 3 runs, considering outbound and return in order -- for a total of 6 trials

Order from MOST Preferred to LEAST Preferred

**Ratings: 0-10 with 10 = excellent
5 = neutral
0 = terrible**

Run 1: Outbound order: _____ rating: _____
Return order: _____ rating: _____

Run 2: Outbound order: _____ rating: _____
Return order: _____ rating: _____

Run 3: Outbound order: _____ rating: _____
Return order: _____ rating: _____

Gender: Male Female Shyness: Very Shy Some Shy Neutral Some Outgoing Very Outgoing

Relation Considered: None Spouse Partner Sibling Parent Child Grandparent Other: _____

HH Size: _____ Licensed Drivers: _____ Private Vehicles: _____

Year of Birth: _____ Household Before-Tax Income per year: _____ Dollars

Figure 3: Survey Sheet Used to Record Responses

4. LIMITATIONS OF WORK

One of the most burdensome parts of the code presented here was the use of the alternative availability function called “nonav” which is used to flag an alternative if it is not available to the survey respondent while a set of travel alternatives is presented. Another limitation of such work

is rooted in the essence of SP data since they are viewed by some scholars as more of a game in which the user might pick an alternative without realizing what the survey is about.

In the case of the research associated with the code supplied here, the author presented the reader with the alternatives' selections, rankings, and ratings "game" six times. The first set of answers were then discarded as they were assumed to be associated with the survey's "learning curve." This in turn was presumed to have reduced the errors made due to not understanding the SP survey or the "game."

5. THE CODE

The coveted ALOGIT code used to estimate a scenario in which alternatives did not belong to any nesting structure can be seen here:

- Code Description: Utility function includes separate parameters for all attributes and no representation of personal characteristics for all games.

- Input file: Pass01.bin

- Output file: Pass01.out

- Base data file PassData.dat

-----Control Lines-----

- There are 56 data items

- Use data values d209 to d214 to list final alternatives in order of preference from best (1st) to worst (5th)

data 58 209 2 7 3*0 4 1 0

- Listing of data items

-d01 = Interviewer ID Number

-d02 = Interview Number

-d03 = Set Number

-d04 = Interviewer Interview Number

-d05 = Day of Interview

-d06 = Month of Interview

-d07 = Game Number (1, 2 or 3)

-d08 = Outbound or Return

- 1=Outbound

- 2=Return

-d09 = Placeholder for 1st most preferred alternative (note later use d209)

-d10 = Placeholder for 2nd most preferred alternative (note later use d210)

-d11 = Placeholder for 3rd most preferred alternative (note later use d211)

-d12 = Placeholder for 4th most preferred alternative (note later use d212)

-d13 = Placeholder for 5th most preferred (actually is least preferred) alternative (note later use d213)

- d14 = Mode for 1st most preferred alternative
 - 1=Bus (note also use letter code 'B')
 - 2=Taxi (note also use letter code 'T')
 - 3=Ride with Friend Already Driving (note also use letter code 'R')

 - 4=Ride with Friend NOT Already Driving (note also use letter code 'D')

 - 5=Ride with HH Relation Already Driving (note also use letter code 'F')

 - 6=Ride with HH Relation NOT Already Driving (note also use letter code 'H')

- d15 = Attribute 1 for 1st most preferred alternative
- d16 = Attribute 2 for 1st most preferred alternative
- d17 = Attribute 3 for 1st most preferred alternative
- d18 = Attribute 4 for 1st most preferred alternative
- d19 = Attribute 5 for 1st most preferred alternative
- d20 = Rating for 1st most preferred alternative (0 to 10)

- d21 = Mode for 2nd most preferred alternative
 - 1=Bus (note also use letter code 'B')
 - 2=Taxi (note also use letter code 'T')
 - 3=Ride with Friend Already Driving (note also use letter code 'R')
 - 4=Ride with Friend NOT Already Driving (note also use letter code 'D')
 - 5=Ride with HH Relation Already Driving (note also use letter code 'F')
 - 6=Ride with HH Relation NOT Already Driving (note also use letter code 'H')

- d22 = Attribute 1 for 2nd most preferred alternative
- d23 = Attribute 2 for 2nd most preferred alternative
- d24 = Attribute 3 for 2nd most preferred alternative
- d25 = Attribute 4 for 2nd most preferred alternative
- d26 = Attribute 5 for 2nd most preferred alternative
- d27 = Rating for 2nd most preferred alternative (0 to 10)

- d28 = Mode for 3rd most preferred alternative
 - 1=Bus (note also use letter code 'B')
 - 2=Taxi (note also use letter code 'T')
 - 3=Ride with Friend Already Driving (note also use letter code 'R')
 - 4=Ride with Friend NOT Already Driving (note also use letter code 'D')
 - 5=Ride with HH Relation Already Driving (note also use letter code 'F')
 - 6=Ride with HH Relation NOT Already Driving (note also use letter code 'H')

- d29 = Attribute 1 for 3rd most preferred alternative

- d30 = Attribute 2 for 3rd most preferred alternative

- d31 = Attribute 3 for 3rd most preferred alternative

- d32 = Attribute 4 for 3rd most preferred alternative

- d33 = Attribute 5 for 3rd most preferred alternative

-d34 = Rating for 3rd most preferred alternative (0 to 10)

-d35 = Mode for 4th most preferred alternative

- 1=Bus (note also use letter code 'B')
- 2=Taxi (note also use letter code 'T')
- 3=Ride with Friend Already Driving (note also use letter code 'R')
- 4=Ride with Friend NOT Already Driving (note also use letter code 'D')
- 5=Ride with HH Relation Already Driving (note also use letter code 'F')
- 6=Ride with HH Relation NOT Already Driving (note also use letter code 'H')

-d36 = Attribute 1 for 4th most preferred alternative

-d37 = Attribute 2 for 4th most preferred alternative

-d38 = Attribute 3 for 4th most preferred alternative

-d39 = Attribute 4 for 4th most preferred alternative

-d40 = Attribute 5 for 4th most preferred alternative

-d41 = Rating for 4th most preferred alternative (0 to 10)

-d42 = Mode for 5th most preferred (actually is least preferred) alternative

- 1=Bus (note also use letter code 'B')
- 2=Taxi (note also use letter code 'T')
- 3=Ride with Friend Already Driving (note also use letter code 'R')
- 4=Ride with Friend NOT Already Driving (note also use letter code 'D')
- 5=Ride with HH Relation Already Driving (note also use letter code 'F')
- 6=Ride with HH Relation NOT Already Driving (note also use letter code 'H')

-d43 = Attribute 1 for 5th most preferred alternative

-d44 = Attribute 2 for 5th most preferred alternative

-d45 = Attribute 3 for 5th most preferred alternative

-d46 = Attribute 4 for 5th most preferred alternative

-d47 = Attribute 5 for 5th most preferred alternative

-d48 = Rating for 5th most preferred alternative (0 to 10)

-d49 = Gender

- 1=male
- 2=female
- -1=no response

-d50 = Shyness

- 1=very shy
- 2=some shy
- 3=neutral
- 4=some outgoing
- 5=very outgoing

-d51 = Actual relation used for considering responses involving HH Relation

- 1=none
- 2=spouse

- 3=partner
- 4=sibling
- 5=parent
- 6=child
- 7=grandparent
- 8=other
- -1=no response

-d52 = Household size (number of people in household) (-1=no response)

-d53 = Number of licenced drivers in household (-1=no response)

-d54 = Number of vehicles in household (-1=no response)

-d55 = Year born (-1=no response)

-d56 = Household Annual Income Before Taxes in Canadian Dollars (-1=no response)

- The number of the alternative in each case is the number of the preference of the alternative (from 1 to 5)

- in the 'tens column' and the mode code number for the alternative (from 1 to 6). For example, the alternative

- number '42' indicates it is the fourth alternative and is taxi

- Nonavailability of alternatives

- The nonavailability flag value is the alternative number plus 100

- Bus (B) not available when flag non-positive

nonav 11,111
nonav 21,121
nonav 31,131
nonav 41,141
nonav 51,151

- Taxi (T) not available when flag non-positive

nonav 12,112
nonav 22,122
nonav 32,132
nonav 42,142
nonav 52,152

- Ride with Friend Already Driving (R) not available when flag non-positive

nonav 13,113
nonav 23,123
nonav 33,133
nonav 43,143
nonav 53,153

- Ride with Friend NOT Already Driving (D) not available when flag non-positive

nonav 14,114

nonav 24,124

nonav 34,134

nonav 44,144

nonav 54,154

- Ride with HH Relation Already Driving (F) not available when flag non-positive

nonav 15,115

nonav 25,125

nonav 35,135

nonav 45,145

nonav 55,155

- Ride with HH Relation NOT Already Driving (H) not available when flag non-positive

nonav 16,116

nonav 26,126

nonav 36,136

nonav 46,146

nonav 56,156

- end

-----Coefficient Specifications-----

- Alternative specific sensitivity parameters

- Bus (B) specific sensitivity parameters

- Bus Walking Distance from Origin to Boarding Stop

11 BWalkOrig

- Bus Ride Time

12 BRide

- Bus Fare

13 BFare

- Bus Walking Distance from Alighting Stop to Destination

14 BWalkDest

- Bus Schedule Mismatch

15 BSchedMis

- Bus Mode Constant

17 BConstant T 0.0

- Bus Mode Correction

19 CCorr T 0.0

- Taxi (T) specific sensitivity parameters

- Taxi Ride Time

22 TRide

- Taxi Fare
23 TFare

- Taxi Schedule Mismatch
25 TSchedMis

- Taxi Mode Constant
27 TConstant

- Taxi Mode Correction
29 TCorr T -0.628712

- Ride with Friend Already Driving (R) specific sensitivity parameters

- R Mode Extra Ride Time for Friend
31 RRideExtraF

- R Mode Ride Time
32 RRide

- R Mode Schedule Mismatch for Friend
34 RSchedMisF

- R Mode Schedule Mismatch
35 RSchedMis

- R Mode Constant
37 RConstant

- R Mode Correction
39 RCorr T -0.514896

- Ride with Friend NOT Already Driving (D) specific sensitivity parameters

- D Mode Ride Time
42 DRide

- D Mode Schedule Mismatch
45 DSchedMis

- D Mode Constant
47 DConstant

- D Mode Correction
49 DCorr T -1.068790

- Ride with HH Relation Already Driving (F) specific sensitivity parameters

- F Mode Extra Ride Time for HH Relation
51 FRideExtraR

- F Mode Ride Time
52 FRide

- F Mode Schedule Mismatch for HH Relation
54 FSchedMisR

- F Mode Schedule Mismatch
55 FSchedMis

- F Mode Constant
57 FConstant

- F Mode Correction
59 FCorr T -0.514896

- Ride with HH Relation NOT Already Driving (H) specific sensitivity parameters
- H Mode Ride Time
62 HRide

- H Mode Schedule Mismatch
65 HSchedMis

- H Mode Constant
67 HConstant

- H Mode Correction
69 HCorr T -1.068790

- Generic sensitivity parameters

- generic ridetime sensitivity parameter
02 Ride

- generic fare sensitivity parameter
03 Fare

- generic schedule mismatch sensitivity parameter
05 SchedMis

-----Transformations-----

- Set availability flags for alternatives. Use the mode code for the alternative to set the availability

- flag to 1 for the alternative that is presented and 0 for the other (unpresented) alternatives.

- Bus (B) availability flags

d111 = ifeq(d14,1)

d121 = ifeq(d21,1)

d131 = ifeq(d28,1)

d141 = ifeq(d35,1)

d151 = ifeq(d42,1)

- Taxi (T) availability flags

-d112 = ifeq(d14,2)

d122 = ifeq(d21,2)

d132 = ifeq(d28,2)

d142 = ifeq(d35,2)

d152 = ifeq(d42,2)

- Ride with Friend Already Driving (R) availability flags

d113 = ifeq(d14,3)

d123 = ifeq(d21,3)

d133 = ifeq(d28,3)

d143 = ifeq(d35,3)

d153 = ifeq(d42,3)

- Ride with Friend NOT Already Driving (D) availability flags

d114 = ifeq(d14,4)

d124 = ifeq(d21,4)

d134 = ifeq(d28,4)

d144 = ifeq(d35,4)

d154 = ifeq(d42,4)

- Ride with HH Relation Already Driving (F) availability flags

d115 = ifeq(d14,5)

d125 = ifeq(d21,5)

d135 = ifeq(d28,5)

d145 = ifeq(d35,5)

d155 = ifeq(d42,5)

- Ride with HH Relation NOT Already Driving (H) availability flags

d116 = ifeq(d14,6)

d126 = ifeq(d21,6)

d136 = ifeq(d28,6)

d146 = ifeq(d35,6)

d156 = ifeq(d42,6)

- Calculate alternative numbers for 1st preference to 5th preference alternatives

Pref1 = 10+d14

Pref2 = 20+d21

Pref3 = 30+d28

Pref4 = 40+d35

Pref5 = 50+d42

- recode ranking data items

d209 = Pref1

d210 = Pref2

d211 = Pref3

d212 = Pref4

d213 = Pref5

- exclusions:

- exclude observations not with males

- exclude = ifne(d49,1)

-----Utility Functions-----

- Bus Alternative Utility Function

- for Alternative 11, which is when 1st preference alternative is Bus (when $d_{14}=1$)

$$U_{11} = p_{11} * d_{15} + p_{12} * d_{16} + p_{13} * d_{17} + p_{14} * d_{18} + p_{05} * d_{19} + p_{17} + p_{19}$$

- for Alternative 21, which is when 2nd preference alternative is Bus (when $d_{21}=1$)

$$U_{21} = p_{11} * d_{22} + p_{12} * d_{23} + p_{13} * d_{24} + p_{14} * d_{25} + p_{05} * d_{26} + p_{17} + p_{19}$$

- for Alternative 31, which is when 3rd preference alternative is Bus (when $d_{28}=1$)

$$U_{31} = p_{11} * d_{29} + p_{12} * d_{30} + p_{13} * d_{31} + p_{14} * d_{32} + p_{05} * d_{33} + p_{17} + p_{19}$$

- for Alternative 41, which is when 4th preference alternative is Bus (when $d_{35}=1$)

$$U_{41} = p_{11} * d_{36} + p_{12} * d_{37} + p_{13} * d_{38} + p_{14} * d_{39} + p_{05} * d_{40} + p_{17} + p_{19}$$

- for Alternative 51, which is when 5th preference alternative is Bus (when $d_{42}=1$)

$$U_{51} = p_{11} * d_{43} + p_{12} * d_{44} + p_{13} * d_{45} + p_{14} * d_{46} + p_{05} * d_{47} + p_{17} + p_{19}$$

- Taxi Alternative Utility Function

- for Alternative 12, which is when 1st preference alternative is Taxi (when $d_{14}=2$)

$$U_{12} = p_{22} * d_{16} + p_{23} * d_{17} + p_{05} * d_{19} + p_{27} + p_{29}$$

- for Alternative 22, which is when 2nd preference alternative is Taxi (when $d_{21}=2$)

$$U_{22} = p_{22} * d_{23} + p_{23} * d_{24} + p_{05} * d_{26} + p_{27} + p_{29}$$

- for Alternative 32, which is when 3rd preference alternative is Taxi (when $d_{28}=2$)

$$U_{32} = p_{22} * d_{30} + p_{23} * d_{31} + p_{05} * d_{33} + p_{27} + p_{29}$$

- for Alternative 42, which is when 4th preference alternative is Taxi (when $d_{35}=2$)

$$U_{42} = p_{22} * d_{37} + p_{23} * d_{38} + p_{05} * d_{40} + p_{27} + p_{29}$$

- for Alternative 52, which is when 5th preference alternative is Taxi (when $d_{42}=2$)

$$U_{52} = p_{22} * d_{44} + p_{23} * d_{45} + p_{05} * d_{47} + p_{27} + p_{29}$$

- Ride with Friend Already Driving Alternative Utility Function

- for Alternative 13, which is when 1st preference alternative is Ride with Friend Already Driving (when $d_{14}=3$)

$$U_{13} = p_{31} * d_{15} + p_{32} * d_{16} + p_{34} * d_{18} + p_{05} * d_{19} + p_{37} + p_{39}$$

- for Alternative 23, which is when 2nd preference alternative is Ride with Friend Already Driving (when $d_{21}=3$)

$$U_{23} = p_{31} * d_{22} + p_{32} * d_{23} + p_{34} * d_{25} + p_{05} * d_{26} + p_{37} + p_{39}$$

- for Alternative 33, which is when 3rd preference alternative is Ride with Friend Already Driving (when $d_{28}=3$)

$$U_{33} = p_{31} * d_{29} + p_{32} * d_{30} + p_{34} * d_{32} + p_{05} * d_{33} + p_{37} + p_{39}$$

- for Alternative 43, which is when 4th preference alternative is Ride with Friend Already Driving (when $d_{35}=3$)

$$U_{43} = p_{31} * d_{36} + p_{32} * d_{37} + p_{34} * d_{39} + p_{05} * d_{40} + p_{37} + p_{39}$$

- for Alternative 53, which is when 5th preference alternative is Ride with Friend Already Driving (when $d_{42}=3$)

$$U_{53} = p_{31} * d_{43} + p_{32} * d_{44} + p_{34} * d_{46} + p_{05} * d_{47} + p_{37} + p_{39}$$

- Ride with Friend NOT Already Driving Alternative Utility Function

- for Alternative 14, which is when 1st preference alternative is Ride with Friend NOT Already Driving (when $d_{14}=4$)

$$U_{14} = p_{42} * d_{16} + p_{05} * d_{19} + p_{47} + p_{49}$$

- for Alternative 24, which is when 2nd preference alternative is Ride with Friend NOT Already Driving (when $d_{21}=4$)

$$U_{24} = p_{42} * d_{23} + p_{05} * d_{26} + p_{47} + p_{49}$$

- for Alternative 34, which is when 3rd preference alternative is Ride with Friend NOT Already Driving (when $d_{28}=4$)

$$U_{34} = p_{42} * d_{30} + p_{05} * d_{33} + p_{47} + p_{49}$$

- for Alternative 44, which is when 4th preference alternative is Ride with Friend NOT Already Driving (when $d_{35}=4$)

$$U_{44} = p_{42} * d_{37} + p_{05} * d_{40} + p_{47} + p_{49}$$

- for Alternative 54, which is when 5th preference alternative is Ride with Friend NOT Already Driving (when $d_{42}=4$)

$$U_{54} = p_{42} * d_{44} + p_{05} * d_{47} + p_{47} + p_{49}$$

- Ride with HH Relation Already Driving Alternative Utility Function

- for Alternative 15, which is when 1st preference alternative is Ride with HH Relation Already Driving (when $d_{14}=5$)

$$U_{15} = p_{51} * d_{15} + p_{52} * d_{16} + p_{54} * d_{18} + p_{05} * d_{19} + p_{57} + p_{59}$$

- for Alternative 25, which is when 2nd preference alternative is Ride with HH Relation Already Driving (when $d_{21}=5$)

$$U_{25} = p_{51} * d_{22} + p_{52} * d_{23} + p_{54} * d_{25} + p_{05} * d_{26} + p_{57} + p_{59}$$

- for Alternative 35, which is when 3rd preference alternative is Ride with HH Relation Already Driving (when $d_{28}=5$)

$$U_{35} = p_{51} * d_{29} + p_{52} * d_{30} + p_{54} * d_{32} + p_{05} * d_{33} + p_{57} + p_{59}$$

- for Alternative 45, which is when 4th preference alternative is Ride with HH Relation Already Driving (when $d_{35}=5$)

$$U_{45} = p_{51} * d_{36} + p_{52} * d_{37} + p_{54} * d_{39} + p_{05} * d_{40} + p_{57} + p_{59}$$

- for Alternative 55, which is when 5th preference alternative is Ride with HH Relation Already Driving (when $d_{42}=5$)

$$U_{55} = p_{51} * d_{43} + p_{52} * d_{44} + p_{54} * d_{46} + p_{05} * d_{47} + p_{57} + p_{59}$$

- Ride with HH Relation NOT Already Driving Alternative Utility Function

- for Alternative 16, which is when 1st preference alternative is Ride with HH Relation NOT Already Driving (when $d_{14}=6$)

$$U_{16} = p_{62} * d_{16} + p_{05} * d_{19} + p_{67} + p_{69}$$

- for Alternative 26, which is when 2nd preference alternative is Ride with HH Relation NOT Already Driving (when $d_{21}=6$)

$$U_{26} = p_{62} * d_{23} + p_{05} * d_{26} + p_{67} + p_{69}$$

- for Alternative 36, which is when 3rd preference alternative is Ride with HH Relation NOT Already Driving (when $d_{28}=6$)

$$U_{36} = p_{62} * d_{30} + p_{05} * d_{33} + p_{67} + p_{69}$$

- for Alternative 46, which is when 4th preference alternative is Ride with HH Relation NOT Already Driving (when $d_{35}=6$)

$$U_{46} = p_{62} * d_{37} + p_{05} * d_{40} + p_{67} + p_{69}$$

- for Alternative 56, which is when 5th preference alternative is Ride with HH Relation NOT Already Driving (when $d_{42}=6$)

$$U_{56} = p_{62} * d_{44} + p_{05} * d_{47} + p_{67} + p_{69}$$

6. CONCLUSIONS

The data collected through the SP survey presented here was put through a rigorous cleaning and processing during which the abbreviations used for alternatives were translated into what could be processed by ALOGIT. The development of an ALOGIT code for researchers especially if it involves nesting structures and various utility functions with details embedded in the survey, can be cumbersome at times. Alternatives to the code provided herein can be used by researchers assuming variations of tree nesting structure are used for their respective logit models. The code herein can be modified should analysis are to be done based on levels of socio-demographic factors such as low, medium, and high-income levels or low, medium, and high shyness levels. In such cases, the respective parameters in the utility function would need to be divided into the number of levels chosen. Based on the complexity of the code required for this work, future research in this area can benefit from more detailed examples especially pertaining to the “nonav” functions provided through the ALOGIT guide.

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